

ORIGINAL ARTICLE

Nutritional and Anthropometric Assessment of the Scope for Dietary Optimization During Staging Prior to Pancreaticoduodenectomy

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ABSTRACT

Context Although several studies have examined peri-operative nutritional supplementation in patients undergoing pancreaticoduodenectomy all provided support at various timepoints with a variety of protocols.

Objective This study undertakes a detailed nutritional and anthropometric assessment of patients due to undergo pancreaticoduodenectomy with particular reference to pre-operative nutritional status and peri-operative outcome.

Patients Twenty-six patients undergoing pancreaticoduodenectomy.

Setting A regional hepatobiliary service.

Main outcome measures Nutritional, anthropometric and clinical course details.

Design Data were collected prospectively.

Results There was no significant change in any anthropometric index from baseline to immediately prior to surgery. However, there was a significant fall in BMI comparing baseline measurements to observations at time of discharge from hospital ($P < 0.001$). There was, in addition, a significant difference between baseline and BMI at 3 months ($P < 0.001$). Similar trends were observed in mid-arm circumference, triceps skin fold thickness and hand-grip. There was no in-hospital or 3-month post-operative mortality in this series.

Conclusion Nutritional and anthropometric indices remain stable from the time of index admission to operation. However, there is a drastic and sustained reduction in nutritional indices in the post-operative period with this deficiency being sustained at 3-months after operation.

INTRODUCTION

Pancreatic cancer is associated with malnutrition and cachexia [1]. Mechanisms of cachexia in this disease include a sustained pro-inflammatory cytokine response, poor dietary intake and the catabolic effects of sepsis [2]. Although overt cachexia is a feature of the latter stages of the illness, lesser degrees of malnutrition may be present in patients with less advanced disease [3]. A recent systematic overview of studies on peri-operative nutritional support in patients undergoing pancreaticoduodenectomy revealed evidence of wide variation in trial protocols with nutritional support being provided prior to surgery or after, using standard or immune-enhanced feed and for varying periods of time after surgery [4]. A consistent theme to emerge is the deficiency of detailed baseline data on nutritional status during the peri-operative period [4]. This deficiency is potentially important as contemporary staging algorithms incorporating detailed multi-modal assessment techniques [5] may create a pre-

operative “window” for facilitation of nutritional support.

The aim of the present study is to undertake a detailed nutritional and anthropometric assessment of patients due to undergo pancreaticoduodenectomy with particular reference to pre-operative nutritional status and peri-operative outcome.

MATERIALS AND METHODS

Study Objective

The aim of this study is to conduct a detailed analysis of patients undergoing pancreaticoduodenectomy for suspected malignancy in order to assess nutritional and anthropometric status prior to surgery and during the peri-operative period.

Study Design

This is a prospective observational cohort study.

Population

The study population comprises patients admitted under the care of an individual hepatobiliary surgeon in a regional hepatopancreatobiliary (HPB) oncology service during the time period from January 2005 to August 2006. All patients had a clinical diagnosis of peri-ampullary or pancreatic tumour and resection by

pancreaticoduodenectomy was planned. Data from patients in whom the final post-resection histology revealed a non-malignant condition are retained in all analyses. For the purposes of this study, the term index admission was defined as the first admission to our hepatobiliary unit (either from an outpatient/office setting, the emergency department or by tertiary referral from another hospital). Twenty six consecutive patients met the inclusion criteria and constitute the study population (Table 1). Fourteen (53.8%) patients were inpatients in referring hospitals before transfer to the regional HPB centre for resection. Seven (26.9%) patients were jaundiced on admission to the unit. The median (range) delay from index admission to surgical resection was 34 (1-65) days. The final histopathological diagnosis of the resection specimens is shown in Table 1.

Data Collection Protocols

Data were collected prospectively from index admission to discharge on: demography, clinical course, tumour-related data, anthropometric measurements, daily calorie intake, operative detail and outcome. Post operative complications were defined using the Association of Upper Gastrointestinal Surgeons of Great Britain and Ireland (AUGIS) database terminology [6] and

Table 1. Demographic and baseline clinical data of the 26 patients undergoing pancreaticoduodenectomy.

Age (range) in years	58 (32-75)
Male:female ratio	10:16
Number who were in-patients prior to admission to regional HPB unit	14 (53.8%)
Median (range) number of days as in-patient prior to transfer to regional HPB unit	10 (1-31)
Median (range) delay between index admission to surgery	34 (1-65)
Final histological diagnosis	Adenocarcinoma of the pancreas: 8 Distal bile duct cholangiocarcinoma: 5 Ampullary adenocarcinoma: 2 Duodenal adenocarcinoma: 2 Chronic pancreatitis: 2 Mucinous cystadenoma: 2 Cystadenocarcinoma: 2 Mesenchymal tumour: 1 Neuroendocrine tumour: 1 Sarcoidosis: 1

Buzby's definitions [7]. All data refer to time from admission to HPB unit to 3 months outpatient follow-up.

A single researcher (KSG) collected data to minimise inter-observer variation. Anthropometric measurements including bodyweight, body mass index, mid-arm circumference, triceps skin fold thickness and hand grip dynamometry were made using standard techniques at index admission, immediately prior to surgery, 10 days after surgery, at hospital discharge and 3 months after surgery. Weight was measured with a mechanical calibrated scale. Height was measured with subjects standing. Triceps skin fold and mid-arm circumference were taken at the level of the midpoint between acromion and olecranon from the non-dominant arm. Triceps skin fold was measured over the triceps muscle with a Harpenden calliper (Baty International, Burgess Hill, United Kingdom) with the arm hanging relaxed at the side. Mid-arm circumference was measured with a flexible inextensible tape at the same level with the elbow flexed at 90°. Grip strength was measured using the dominant arm with the patient upright and using a hand-grip dynamometer. In all measurements, the mean of three readings is reported.

Nutritional status was assessed using the subjective global assessment technique which relies on the patient's history: weight loss, changes in dietary intake, gastrointestinal symptoms; physical examination: subcutaneous fat, sacral and ankle oedema, and presence or absence of ascites and the clinician's overall judgment of the patient's status. Three grades are used: normal (grade A), mildly (grade B) or significantly malnourished (grade C) [8]. Food intake during out-of-hospital periods after the index admission was recorded using a food diary recorded at home after discharge from hospital (post-op) and at completion of staging tests (pre-op). The inpatient records of nutritional intervention from post-op day 1 to the time of discharge were collected, specifically, mode of delivery of nutritional supplement, feed composition and proportion of calculated daily nutritional requirements

achieved. Energy and protein intake were calculated using validated software packages [9].

Clinical Care in Relation to Conduct of Pancreaticoduodenectomy and Peri-Operative Care

During the period of the study pre-operative nutritional supplementation was not a standard component of the pre-operative protocol. Patients were routinely assessed by a trained dietitian independent of the study at the time of their index admission and then again in the post-operative period. If supplemental nutrition was thought to be clinically indicated at the time of the index assessment, Fortisip® (Nutricia, Dublin, Ireland) was prescribed. Those patients receiving pre-operative supplementation are recorded. A standard operative technique was used for pancreaticoduodenectomy [10]. A feeding jejunostomy was not sited routinely. If a feeding jejunostomy or nasojejunal feeding tube was used, the Frecka (Frecka, Chicago, IL, USA) was selected and feeding normally commenced on the first post-operative day and increased according to a step-up protocol as tolerated by the patient. Parenteral nutrition was used if nasojejunal tube dislodgement occurred and if oral intake was insufficient to maintain planned calorie intake. Prokinetics were not routinely used.

Endpoints

The main endpoints are: change in anthropometric data from baseline to immediately prior to surgery and also from this pre-operative assessment to time points after surgery. Whole group comparisons are presented as well as a comparison of the subgroup with jaundice to non-jaundiced patients. Related endpoints are the complication profile and relation to percentage weight loss.

STATISTICS

Data were entered into the Statistical Package for the Social Sciences, version 12.0 (SPSS, Chicago, IL, USA) for statistical analysis. Data are presented as frequencies and median

Table 2. Anthropometric data.

	Median (range)	P value ^a
BMI (kg/m²)		
- Baseline	24.2 (18.9-33.6)	-
- Immediate pre-op	23.6 (17.7-33.6)	0.676
- Time of discharge	22.5 (16.8-31.8)	<0.001
- 3 months post-op	21.5 (17.5-28)	<0.001
Mid-arm circ. (cm)		
- Baseline	29.5 (22-35)	-
- Immediate pre-op	28 (22-36)	0.434
- Time of discharge	26.5 (19-32)	0.016
- 3 months post-op	25 (22.5-30.5)	<0.001
Triceps skinfold (mm)		
- Baseline	14 (6.2-30)	-
- Immediate pre-op	13.7 (6.5-29)	0.411
- Time of discharge	11.6 (2.6-28.5)	0.073
- 3 months post-op	11.9 (1.6-21)	<0.001
Hand-grip (kg)		
- Baseline	27 (13.3-59.3)	-
- Immediate pre-op	23 (11-58)	0.465
- Time of discharge	19.6 (9.3-50.3)	0.009
- 3 months post-op	19.3 (9.6-40)	<0.001

BMI: body mass index

circ: circumference

^a P values compared to baseline (Wilcoxon matched-pairs test)

(range). Comparisons between groups are made using non-parametric tests (Wilcoxon matched-pairs test) accepting significance at the 0.05 two-tailed P level.

ETHICS

The study was approved by the Central Manchester Research Ethics Committee and registered as a full clinical study with the Research and Development (R&D) office of the Manchester Royal Infirmary and was conducted according to the principles of the Helsinki declaration.

RESULTS

Anthropometric Data

There was no significant change in any anthropometric index from baseline to immediately prior to surgery (Table 2). However, there was a significant fall in BMI comparing baseline measurements to observations at time of discharge from hospital (P<0.001). There was, in addition, a

significant difference between baseline and BMI at 3 months (P<0.001). The difference between BMI at discharge and at 3 months was not significant (P=0.543). Similar trends were observed in mid-arm circumference, triceps skin fold thickness and hand-grip. Median pre-operative calorie intake was 1,945 (1,134-2,942) kcal/day with protein consumption being 85 (47-134) g/day. Anthropometric changes for patients with jaundice is seen in Table 3.

Nutritional Data

Five patients had nutritional supplementation prior to surgery. The median duration of pre-operative nutritional supplementation in these individuals was 24 (17-28) days. Thirteen (50.0%) patients had some form of nutritional supplementation in the post-operative period. The mode of delivery of supplemental nutrition in these patients was as follows: nasojejunal tube, 11; parenteral nutrition, 2. The median duration of post-operative

Table 3. Anthropometric data in the subgroup with jaundice.

	Median (range)	P value ^a
BMI (kg/m²)		
- Baseline	25.7 (24-27.3)	-
- Immediate pre-op	24.9 (19.8-26.6)	0.683
- Time of discharge	22.9 (17.2-29.6)	0.296
- 3 months post-op	22.8 (21.8-24.7)	0.296
Mid-arm circ. (cm)		
- Baseline	30.5 (29-32)	-
- Immediate pre-op	29 (23-32)	0.437
- Time of discharge	26 (21-30)	0.218
- 3 months post-op	25.6 (24.5-28.7)	0.296
Triceps skinfold (mm)		
- Baseline	13.4 (6.2-19.3)	-
- Immediate pre-op	12.6 (6.5-19.3)	0.812
- Time of discharge	11.4 (2.6-17.5)	0.468
- 3 months post-op	10.5 (1.6-14.9)	0.296
Hand-grip (kg)		
- Baseline	27.5 (21.3-54.6)	-
- Immediate pre-op	25.6 (11-54.6)	0.562
- Time of discharge	19 (10-43.6)	0.156
- 3 months post-op	21.5 (18.6-40)	0.156

BMI: body mass index

circ: circumference

^a P values compared to baseline (Wilcoxon matched-pairs test)

supplementation was 20 (12-34) days. Two of the nasojejunal tube group went on to require parenteral nutrition because of tube dislodgement combined with ongoing gastric stasis and thus a total of 4 patients received post-operative parenteral nutritional support. Overall post-operative calorie intake (sampled prior to discharge from hospital) was 1,565 (1,114-2,653) kcal/day with protein intake comprising 68.5 (52-81) g/day of this. Paired pre- and post-operative calorie intake data (sampled prior to discharge from hospital) were complete for 8 patients. There was no significant difference between pre- and post-operative calorie intake in this paired analysis ($P=0.792$). Nutritional status assessed on admission using the subjective global assessment technique was graded as normal (A) in 15, mildly malnourished (B) in 7 and severely malnourished in 1 (C). Three patients were unable to recall their pre-illness body weight and hence an subjective global assessment grade could not be assigned.

The median baseline albumin was 36 (28-45) g/L (The laboratory reference range for albumin is 30-48 g/L). The immediate pre-operative median value was 42 (26-46) g/L, and at discharge from hospital was 43 (28-49) g/L ($P=0.427$ and $P=0.167$ vs. baseline, respectively).

Clinical Course Data

Median operative time was 545 (400-675) minutes. The placement of a feeding jejunostomy made no difference to operating time ($P=0.543$). No patients required re-operation and there were no complications attributable to feeding jejunostomy or nasojejunal tube placement. Median post-operative stay in surgical high-dependency unit was 3 (2-26) days and overall in-patient stay after surgery was 31 (11-47) days.

There were no in-hospital or 3-month post-surgery deaths in this series. Five patients (19.2%) had a pancreatic leak (defined as amylase rich discharge of greater than threefold maximal serum amylase after the 7th post-operative day). No patient required either surgical or radiological intervention for anastomotic leak. Eight patients (30.8%) had

gastric stasis (defined as the presence of post-operative gastric dysfunction leading to a longer hospital stay or treatment extending beyond post-op day 10). Of the 12 patients who had a major post-operative complication, only 2 had received both pre-operative oral nutrition supplements and post operative nutrition support.

DISCUSSION

This report is a prospective observational study examining anthropometric indices, nutritional status and complications in a cohort of patients undergoing pancreaticoduodenectomy. When interpreting these descriptive data, it should be remembered that although the observations are detailed, this is a small study sample (and hence relatively prone for findings to be skewed by outlying datapoints), that the patients constitute a highly selected cohort and that individual surgeon-related and service-related factors are likely to influence findings.

As a counterpoint, it could be argued that oncologic selection criteria for patients to undergo pancreaticoduodenectomy are well-recognised [11] and the outcomes reported here are simply reflective of the good results of pancreaticoduodenectomy seen in many high-volume cancer centres [12, 13].

The rationale for the study rests on the relative dearth of information on pre-operative nutritional status in patients selected for pancreaticoduodenectomy in current pancreatic oncological practice [4]. Studies of peri-operative nutritional support have evaluated a wide range of protocols, employing a range of nutritional delivery and for a widely varying period of time. In the current era of sophisticated pre-operative staging, there is a potential 'window of opportunity' for pre-operative nutritional supplementation.

Our findings suggest that there is little difference between baseline (index admission) and pre-operative BMI and nutritional indices in this cohort. As there were no healthy controls, it is possible that values were lower than control at both time-points but given the normal BMI this is

relatively unlikely. Five patients did receive pre-operative nutritional supplementation. However, their baseline BMI at index admission were respectively 24.0, 25.5, 25.7, 26.2, and 27.3 kg/m² and thus it appears that the clinical decision to provide supplemental nutrition in these patients was not related to evidence of malnutrition at basal assessment and no sub-group analyses have been undertaken.

What then are the key findings of this study? First, it would appear that for the majority of patients undergoing pancreaticoduodenectomy for suspected cancer, there is little advantage in pre-operative supplemental nutrition during the pre-operative period. Second, it is apparent that there is a striking fall in BMI with associated deterioration in anthropometric indices after surgery and that recovery has not taken place by 3-months after surgery.

In keeping with contemporary pancreatic oncological practice, the operative mortality and overall complication profile is low. The prolonged in-patient stay is difficult to account for with absolute certainty but is thought to relate to the profile of an urban tertiary centre serving a geographically wide and remote hinterland including the British Lake District. Sub-group analyses were avoided but there does not seem to be a relation between post-operative complications and nutritional status. However, an important omission of this study was the measurement of quality of life data and it is thought likely that quality of life would be impaired in nutritionally deplete individuals [14].

In summary, this study provides detailed nutritional and anthropometric reference information in a contemporary cohort of patients undergoing pancreaticoduodenectomy for cancer. Nutritional and anthropometric indices remain stable from the time of index admission to operation and there does not appear to be a strong case for pre-operative nutritional supplementation. However, there is a drastic and sustained reduction in nutritional indices in the post-operative period with this deficiency being sustained at 3 months after operation. This finding is

important and suggests that attention to post-operative nutritional status is important and potentially, post-operative nutritional supplementation sustained for 3 months may be of benefit. Future protocols should concentrate on this post-operative period and given the low complication profile of pancreaticoduodenectomy in current oncologic practice, the emphasis should be on quality of life measures and longer-term follow-up.

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Keywords Anthropometry; Nutrition Assessment; Pancreaticoduodenectomy

Abbreviations HPB: hepatopancreatobiliary

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